Test Tuesday 5/15

- Electrostatics
- Circuits

Electric field equation:

$$E = \frac{k|q|}{r^2}$$

this equation gives the magnitude of the electric field

direction comes from arrows of the electric field

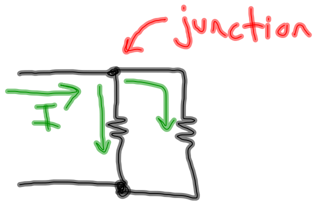
- if there are multiple charges, we must calculate electric field from each.

Resistors:

- The point of resistors is to control current
- Two ways to connect pieces:

1. Series

2. Parallel



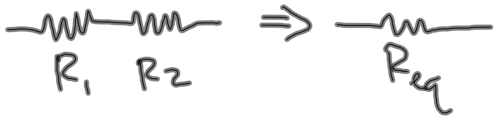
- There is a relationship between current, voltage, and resistance:

$$V=IR$$

voltage = (current)(resistance)

Ohm's law

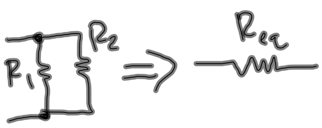
- Equivalent resistance:
  - Series

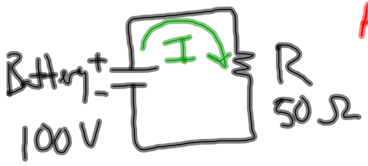


$$R_{eq}=R_1+R_2$$

- Parallel

$$\frac{1}{R_{eq}}=\frac{1}{R_1}+\frac{1}{R_2}$$

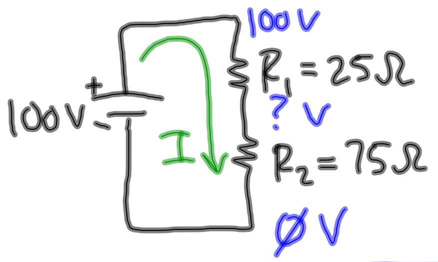




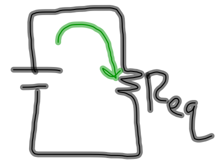
Assume wire do not have any resistance

$V = IR$

$I = \frac{V}{R} = \frac{100\ V}{50\ \Omega} = 2\ A$



⇒



$R_{eq} = R_1 + R_2$
$= 100\ \Omega$

Pieces in series share current.
They have different voltage drops.

$I_{total} = \frac{V_{battery}}{R_{eq}} = \frac{100\ V}{100\ \Omega} = 1\ A$

$V_1 = I_{total} R_1 = (1\ A)(25\ \Omega) = 25\ V$

amount of voltage each resistor is using.

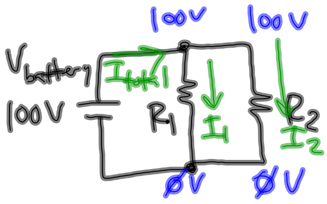
$V_2 = I_{total} R_2 = (1\ A)(75\ \Omega) = 75\ V$

"voltage drop"

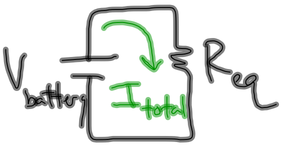
$V_1 + V_2 = V_{battery}$

$25\ V + 75\ V = 100\ V$ ✓

All voltage drops must add



$\Rightarrow$



$R_1 = 25\,\Omega$

$R_2 = 75\,\Omega$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R_{eq} = \left[\frac{1}{25\,\Omega} + \frac{1}{75\,\Omega}\right]^{-1}$$

Calculator: $((1/25)+(1/75))^{-1}$

$$R_{eq} = 18.75\,\Omega$$

$$I_{total} = \frac{V_{battery}}{R_{eq}} = \frac{100\,V}{18.75\,\Omega} = 5.33\,A$$

Pieces in parallel share voltage.
They have different currents.

$$I_1 = \frac{V_{battery}}{R_1} = \frac{100\,V}{25\,\Omega} = 4\,A$$

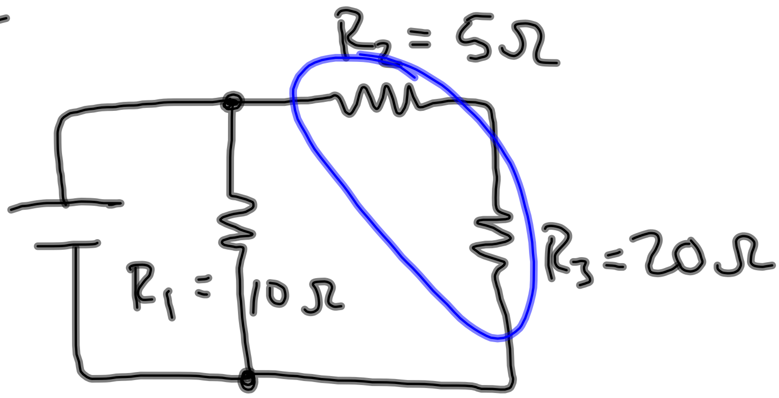
$$I_2 = \frac{V_{battery}}{R_2} = \frac{100\,V}{75\,\Omega} = 1.33\,A$$

$$I_1 + I_2 = I_{total}$$

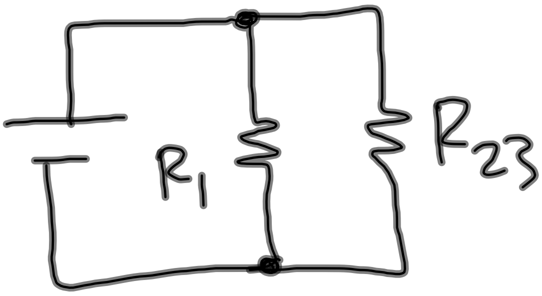
$$4\,A + 1.33\,A = 5.33\,A \checkmark$$

Current in each branch must equal
the total current coming into the branche

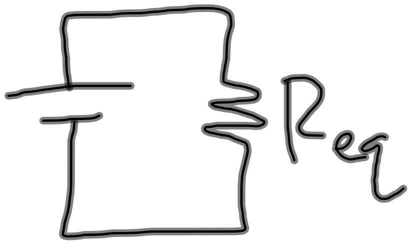
Equivalent Resistance Practice:



Start with resistor that is farthest from battery and work towards the battery

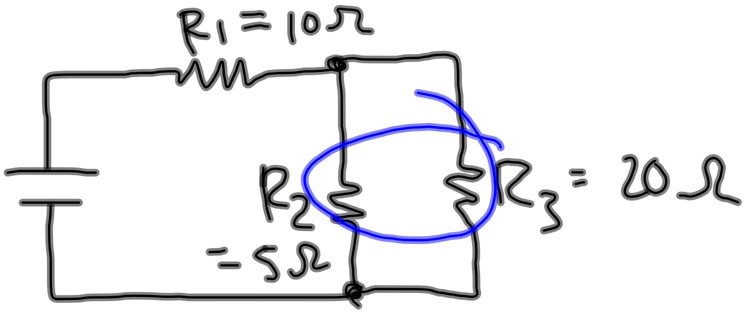


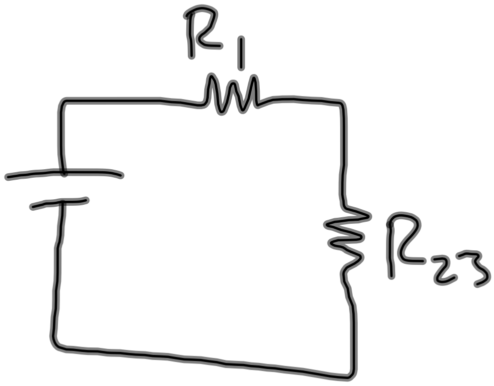
$$R_{23} = R_2 + R_3$$
$$= 25\Omega$$



$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_{23}}$$

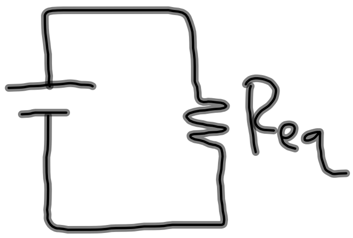
$$R_{eq} = 7.14\Omega$$





$$\frac{1}{R_{23}} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$R_{23} = 4\,\Omega$$



$$R_{eq} = R_1 + R_{23}$$

$$= 14\,\Omega$$

Electric Power:

$$P = IV$$

Units are still Watts

$$P = I^2 R = \frac{V^2}{R}$$